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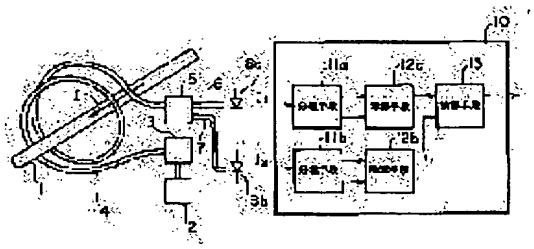
(54) OPTICAL FIBER TYPE MEASURING INSTRUMENT AND METHOD

(57)Abstract:

PURPOSE: To accurately measure current or magnetic field by eliminating an error due to the unbalance of characteristics of a photoelectric conversion element etc., and fluctuation of the reference polarization azimuth of an optical fiber.



CONSTITUTION: An optical fiber 4 is provided around a conduction conductor 1. Laser beams from a semiconductor laser light source 2 for supplying measurement light are fed to the optical fiber 4 after the laser beams are converted into linear polarization by a polarizer 3. The polarization angle of the polarization surface of the beams is changed by current I. The irradiation beams of the optical fiber 4 are separated into p and s waves by a polarizer 5, are converted into voltage signals by photodiodes 8a and 8b. and are separated into AC and DC components by

separation means 11a and 11b and a first component ratio and a second component ratio of AC and DC components are obtained by division means 12a and 12b. respectively, and the difference is obtained by an operation means 13. The value of the current I is measured from the output of the operation means 13.

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the optical fiber mold metering device which performs measurement of a current or a magnetic field from change of the plane of polarization by the Faraday effect of the light by which outgoing radiation was carried out from the optical fiber energization -- it being prepared in the perimeter of a conductor or a magnetic field, and with the optical fiber made from lead glass to which the light guide of the light is carried out A polarization separation means to separate into the 1st polarization and the 2nd polarization which have plane of polarization which is mutually different in the outgoing radiation light of said optical fiber, A photoelectricity conversion means to change respectively said 1st polarization and said 2nd polarization into the 1st polarization electrical signal and the 2nd polarization electrical signal, A separation means to divide respectively said 1st polarization electrical signal and said 2nd polarization electrical signal into the 1st alternating current component, the 1st dc component and the 2nd alternating current component, and the 2nd dc component, The optical fiber mold metering device characterized by having a division means to ask for the 1st component ratio of said 1st alternating current component and said 1st dc component, and the 2nd component ratio of said 2nd alternating current component and said 2nd dc component respectively, and an operation means to ask for the difference or the sum of said 1st component ratio and said 2nd component ratio.
[Claim 2] Said operation means is an optical fiber mold metering device according to claim 1 characterized by constituting so that the value which changes in time [said current or said magnetic field] may be calculated by searching for the difference of said 1st component and said 2nd component.
[Claim 3] It is the optical fiber mold metering device according to claim 1 which said separation means has respectively a conversion means to change said 1st alternating current component and said 2nd alternating current component into actual value, and is characterized by constituting said operation means so that it may ask for the sum of said 1st component ratio and said 2nd component ratio.
[Claim 4] Said optical fiber is SiO2. PbO is included and it is said SiO2. Optical fiber mold metering device according to claim 1 with which weight % is characterized by being lead glass said whose weight of PbO is 85 - 65% 5 to 35%.
[Claim 5] In the optical fiber mold measurement approach of performing measurement of a current or a magnetic field from change of the plane of polarization by the Faraday effect of the light by which outgoing radiation was carried out from the optical fiber It prepares in the perimeter of a conductor or a magnetic field. the optical fiber made from lead glass to which the light guide of the light is carried out -- energization -- It separates into the 1st polarization and the 2nd polarization which have plane of polarization which is mutually different in the outgoing radiation light of said optical fiber. Said 1st polarization and said 2nd polarization are respectively changed into the 1st polarization electrical signal and the 2nd polarization electrical signal. Respectively said 1st polarization electrical signal and said 2nd polarization electrical signal The 1st alternating current component, It separates into the 1st dc component and the 2nd alternating current component, and the 2nd dc component. The 1st component ratio of said 1st alternating current component and said 1st dc component, The optical fiber mold measurement approach characterized by asking for the 2nd component ratio of said 2nd alternating

current component and said 2nd dc component respectively, asking for the difference or the sum of said 1st component ratio and said 2nd component ratio, and measuring a current or a magnetic field.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the optical fiber mold metering device and the measurement approach of measuring the current or magnetic field using the Faraday effect of an optical fiber.
[0002]
[Description of the Prior Art] As a current metering device using the Faraday effect of an optical fiber, it is R.I.Laming and D.N.Payne, for example.; Journal of Lightwave Technology, Vol.7, and No.12 2084 (1989) What is indicated is known. Drawing 7 is drawing showing the basic configuration of the conventional optical fiber mold current metering device. energization -- Current I is flowing to the conductor 1. energization -- the optical fiber 4 which has the Faraday effect is twisted around the conductor 1. The light by which outgoing radiation was carried out from the semiconductor laser light source 2 is changed into the linearly polarized light with a polarizer 3, and is sent to an optical fiber 4. A current can be measured by change of the rotatory polarization include angle of the light sent out to the optical fiber 4 according to such optical system. Electrical treatment of the obtained light is performed as follows. The light by which outgoing radiation was carried out is separated into s wave and p wave from an optical fiber 4 by the polarization beam splitter 5. Photo electric conversion of the p wave which carries out outgoing radiation and goes straight on from a beam splitter 5 is carried out by photodiode 8a, and an another side s wave advances so that it may intersect perpendicularly by the beam splitter 5, and photo electric conversion is carried out by photodiode 8b. The voltage signal I1 by which photo electric conversion was carried out next with each photodiode, and I2 It is inputted into the data-processing section 50, and is processed as the following formula.
[0003]
[Equation 1] (I1 -I2)/(I1 +I2)
The variation theta of the polarization angle of the light generated in the optical fiber based on the result of this formula can be computed, and, finally a current value can be acquired.
[0004] namely, energization -- if it sets up so that it may become a conductor 1 with the direction of 45 degrees to the shaft of a beam splitter 5 about the direction (this is henceforth called "criteria polarization bearing") of plane of polarization in case the condition, i.e., a faraday's rotation angle, that the current is not flowing is zero, and a faraday's rotation angle is written to be theta -- [0005]
[Equation 2] sin2theta=(I1-I2)/(I1+I2)
There is relation to say and theta is calculated from this. moreover, theta -- a current -- the Verdet constant of I and an optical fiber -- energization of V and an optical fiber -- the number of the circumference to a conductor -- N, then [0006]
[Equation 3] There is relation called theta=VNI and it is [0007].
[Equation 4] It can come I=theta/VN and Current I can be found more. theta can approximate with sin2theta=2theta, when small.
[0008] Drawing 8 is the circuit diagram of the data-processing section which performs the above-

mentioned operation. The data-processing section 50 consists of the amplifier 51a and 51b which amplifies the voltage signal acquired from Photodiodes 8a and 8b, the arithmetic element 52 which acquires the difference of the voltage signal acquired from Amplifier 51a and 51b, an arithmetic element 53 which obtains the sum of the voltage signal acquired from Amplifier 51a and 51b, and an arithmetic element 54 which takes the ratio of the output of an arithmetic element 52, and the output of an arithmetic element 53.

[0009] It is an output I1 and I2 from Amplifier 51a and 51b, respectively. It is obtained. an output (I1+I2) obtains from the output (I1-I2) from an arithmetic element 52, and an arithmetic element 53 -- having -- an arithmetic element 54 -- those ratios (I1-I2) -- / (I1+I2) is outputted.

[0010]

[Problem(s) to be Solved by the Invention] By the way, generally as an optical fiber of such a current metering device, quartz glass fiber or lead glass fiber is used.

[0011] An opto elastic constant is large, the stress induced birefringence based on a birefringence or a temperature change by residual stress of a fiber etc. is large, and a quartz fiber tends to produce the error of current measurement. In order to reduce the instability of the polarization property by such birefringence, the method of giving big **** to a fiber is also proposed. Although it was the attempt in which this would be twisted using the large thing of an opto elastic constant, and the stability of plane-of-polarization bearing would be maintained with stress, the stability over change of environments, like originally, since the opto elastic constant is large, with deformation of a fiber, the stress from the outside, etc., a random birefringence occurs easily and a temperature change and vibration are added was inadequate.

[0012] On the other hand, lead glass fiber has the advantage of there being few errors by stress induced birefringence since the opto elastic constant is very small, and being hard to be influenced of the stress by the environmental variation. However, criteria polarization bearing cannot be stabilized with a means to give a twist conversely to a fiber with lead glass fiber since the opto elastic constant is very small. moreover -- even if it sets up criteria polarization bearing once -- energization -- when the geometry of the fiber which winds a conductor changes under change of an outside temperature, and the effect of prolonged use, changing from the direction set up first occurs plentifully. Therefore, since measured value generated the measurement error as dispersion and a result when lead glass fiber was used for the optical fiber 4 of drawing 7 , and the output was processed in the data-processing section 50, and changing criteria polarization bearing by deformation and vibration of a fiber, there was a trouble that the advantage of lead glass fiber was not fully demonstrated.

[0013] Moreover, at the data-processing section 50 shown in drawing 8 , it is I1 and I2 by the imbalance of the property of two photodiodes 8a and 8b, or the imbalance of the amplification degree of Amplifier 51a and 51b. In order to change, there is also a trouble of producing a measurement error.

[0014] This invention is being made in view of such a point, and the purpose's removing the error by the imbalance of properties, such as an optoelectric transducer, and the error based on the fluctuation of criteria polarization bearing of light which carries out outgoing radiation, and offering a highly precise current or the optical fiber mold metering device which can measure a magnetic field.

[0015] Furthermore, other purposes of this invention are removing the error by the imbalance of properties, such as an optoelectric transducer, and the error based on fluctuation of criteria polarization bearing, and offering a highly precise current or the optical fiber mold measurement approach which can measure a magnetic field.

[0016]

[Means for Solving the Problem] In the optical fiber mold metering device which performs measurement of a current or a magnetic field from change of the plane of polarization by the Faraday effect of the light by which outgoing radiation was carried out from the optical fiber in order to solve the above-mentioned technical problem in this invention energization -- it being prepared in the perimeter of a conductor or a magnetic field, and with the optical fiber made from lead glass to which the light guide of the light is carried out A polarization separation means to separate into the 1st polarization and the 2nd polarization which have plane of polarization which is mutually different in the outgoing radiation light

of said optical fiber, A photoelectricity conversion means to change respectively said 1st polarization and said 2nd polarization into the 1st polarization electrical signal and the 2nd polarization electrical signal, A separation means to divide respectively said 1st polarization electrical signal and said 2nd polarization electrical signal into the 1st alternating current component, the 1st dc component and the 2nd alternating current component, and the 2nd dc component, A division means to ask for the 1st component ratio of said 1st alternating current component and said 1st dc component, and the 2nd component ratio of said 2nd alternating current component and said 2nd dc component respectively, The optical fiber mold metering device characterized by having an operation means to ask for the difference or the sum of said 1st component ratio and said 2nd component ratio is offered.
[0017]
[Function] The light guide of the light is carried out to an optical fiber, and, as for the outgoing radiation light, plane of polarization changes with a current or magnetic fields. It separates into the 1st polarization and the 2nd polarization which have the plane of polarization which changed the outgoing radiation light mutually with polarization separation means, and changes into the 1st polarization electrical signal and the 2nd polarization electrical signal with a photo-electric-conversion means. And the 1st polarization electrical signal and the 2nd polarization electrical signal are separated into the 1st alternating current component, the 1st dc component, the 2nd alternating current component, and the 2nd dc component by the separation means. Furthermore, it asks for the 1st component ratio and the 2nd component ratio with a division means.
[0018] By asking for the component ratio of each alternating current component and dc component, the error by the imbalance of the property of each photo-electric-conversion means is removed. Moreover, it asks for the difference or the sum of the 1st component ratio and the 2nd component ratio with an operation means. The error by change of criteria polarization bearing is removed by this.
[0019] And measurement of a current or a magnetic field without the error by the imbalance of the property of a photo-electric-conversion means and the error by change of criteria polarization bearing can be performed.
[0020]
[Example] Hereafter, one example of this invention is explained based on a drawing. Drawing 1 is the principle Fig. of this invention. this invention -- from optical system and the data-processing section -- becoming -- optical system -- energization -- with the optical fiber 4 which consists of lead glass wound twice around the conductor 1 The polarizer 3 which makes light by which outgoing radiation was carried out to this optical fiber 4 from the semiconductor laser light source 2 which supplies a measuring beam, and the semiconductor laser light source 2 the linearly polarized light, The polarization which has the plane of polarization which intersected perpendicularly mutually the light by which outgoing radiation was carried out from the optical fiber 4, That is, it consists of photodiodes 8a and 8b which change into a voltage signal the light by which the light guide was carried out to the quartz glass fiber 6 and 7 which carries out the light guide of the measuring beam by which outgoing radiation was carried out, and quartz glass fiber 6 and 7 from the analyzer 5 divided into s component and p component, and an analyzer 5.
[0021] An optical fiber 4 is a three-tiered structure optical fiber which consists of a core made from lead glass, a clad, and an exaggerated clad, and the presentation is as follows.
Core glass presentation (all are weight %)
SiO2 : 27.10%PbO : 71.10%Na2 O: 0.20%K2 O : 1.30% clad glass presentation SiO2 : 27.25%PbO : 70.95%Na2 O: 0.20%K2 O : It is SiO2 1.30% here. PbO is the principal component of lead glass. Na2 O and K2 O are components which maintain a vitreous state at stability by promoting vitrification and controlling crystallization.
exaggerated -- clad glass presentation SiO2 1.31%Cr2 O3: 0.05%Cu2 O : [ ] -- 1.01%, SiO2 and PbO are the principal components of lead glass, and the component, and Cr 2O3 and Cu2 O to which Na2 O promotes vitrification are an absorbent for absorbing the clad mode of an optical fiber here. : 27.23% PbO : 70.42%Na2 O :
[0022] Moreover, each diameter and refractive index are as follows.

	直径	屈折率
コア	5．7μm	1．85186
クラッド	31．7μm	1．84857
オーバークラッド	125μm	1．85746

0.17%, 0.11 and normalized radiam frequency of numerical aperture are 2.35, and the relative index difference of a fiber fulfills single mode conditions to light with a wavelength of 850nm. The Verdet constants were about 0.04 min/Oe-cm on the wavelength of 850nm.
[0023] Incidence of the measuring beam which carried out outgoing radiation from the semiconductor laser light source 2 by the above configuration is carried out to the glory fiber 4 changed into the linearly polarized light by the polarizer 3. the light which carried out incidence to the optical fiber 4 -- energization -- according to the magnitude of the current which passes the part which are surrounding the conductor 1, plane of polarization rotates and outgoing radiation is carried out by the Faraday effect from an optical fiber 4. Outgoing radiation is carried out, incidence of the measuring beam is carried out to an analyzer 5, and it is separated into s wave and p wave by this analyzer 5. The light guide of the p wave is carried out to photodiode 8a with quartz glass fiber 6, and the light guide of the s wave is carried out to photodiode 8b with quartz glass fiber 7.
[0024] The data-processing section 10 consists of an operation means 13 to ask for the difference or the sum of separation means 11a and 11b to divide a polarization electrical signal into an alternating current and a direct current, division means 12a and 12b to ask for the component ratio of each alternating current component and dc component, and a component ratio.
[0025] With the separation means 11a and 11b, it separates into an alternating current component and a dc component, and the 1st polarization electrical signal and the 2nd polarization electrical signal which were outputted from Photodiodes 8a and 8b become the 1st alternating current component, the 1st dc component, the 2nd alternating current component, and the 2nd dc component. Furthermore, it asks for the 2nd component ratio which are the 1st component ratio which is a ratio of the 1st alternating current component and the 1st dc component, and a ratio of the 2nd alternating current component and the 2nd dc component with the division means 12a and 12b. And it asks for the difference or the sum of the 1st component ratio and the 2nd component ratio with the operation means 13.
[0026] Next, actuation of the data-processing section 10 is explained quantitatively. Drawing 2 is drawing explaining criteria polarization bearing. As shown in drawing, the criteria polarization bearing Er is set up so that the include angle of 45 degrees may be made to the shaft of an analyzer. However, when only an include angle delta shifts from 45 degrees and this serves as Era, it is the faraday's rotation angle caused by the measurement current theta then the voltage signal I1 of Photodiodes 8a and 8b, and I2 [0027]
[Equation 5] I1 =A* (1+sin (2theta+2delta))
I2 =B* (1-sin (2theta+2delta))
It becomes. A and B are the amplification degree of the photodiodes 8a and 8b to each polarization component here. In A=B, with the conventional method, it is [0028].
[Equation 6] S**(I1-I2)/(I1+I2) =cos (2theta+2delta)
It comes out, and it is and, as for a faraday's rotation angle, only delta produces a gap error. delta will change with deformation of a fiber winding configuration or vibration of a fiber, and the error by the drift at the time of using it for a long period of time and the random error by vibration will be included in measured value as a result. Moreover, an error is produced also when A differs from B.
[0029] When measuring alternating current, since theta changes with time amount according to alternating current, it describes it as theta (t). At this time, it is the passed current j(t) =j0 When sinomegat, the faraday's rotation angle corresponding to this is [0030].
[Equation 7] theta(t) =theta0 It is sinomegat and a faraday's rotation angle vibrates by omega. V is the Verdet constant, N is the number of turns of an optical fiber, and it is [0031] here.
[Equation 8] It is theta0 =VNj0.

[0032] It is the voltage signal of the return photodiodes 8a and 8b to drawing 1 I1 and I2 It is [0033] when it carries out.
[Equation 9]
I1 (t) =A* (1+sin (2theta (t) +2delta))
I2 (t) =B* (1-sin (2theta (t) +2delta))
Although expressed, theta (t) and delta are both [0034], when small.
[Equation 10]
sin(2theta (t) +2delta) **2theta (t) Since it is +2delta, it is [0035].
[Equation 11]
I1 (t) =A0 * (1+2delta+2theta (t))
I2 (t) =B0 * (1-2delta-2theta (t))
It can approximate.
[0036] Next, it is I1 with the separation means 11a and 11b. (t) and I2 (t) Each is divided into an alternating current component (2theta (t), -2theta (t)) and a dc component (1+2delta, 1-2delta). And it asks for the component ratio of each alternating current component and dc component with the division means 12a and 12b. They are those component ratios to order M1 (t) and M2 It is [0037], when it is written as (t) and approximation called delta<<1 is used.
[Equation 12] M1 (t) =A0 *[2theta(t)]/A0 * (1+2delta)
**2theta (t) (1-2delta)
M2 (t) =B0 *[-2theta(t)]/B0 * (1-2delta)
**-2theta (t) (1+2delta)
It becomes. It is amplification degree A0 and B0 so that clearly from this formula. It is eliminated and the measurement error by it is lost.
[0038] And it is M1 with the operation means 13. (t) and M2 It is [0039] when the difference of (t) is searched for.
[Equation 13] M1 (t)-M2 (t) =4theta (t)
A next door and M1 (t) and M2 The gap delta of criteria polarization bearing can be offset by taking the difference of (t). And [0040]
[Equation 14]
theta(t) =theta0 Sinomegat=VNj 0 Since it is sinomegat, it is [0041].
[Equation 15] It can ask for current j (t) from j(t) = j-sinomegat=theta (t) / VN.
[0042] Next, the example of the data-processing section 10 is described. Drawing 3 is the circuit diagram of the 1st example of the data-processing section. The data-processing section 20 consists of the amplifier 21a and 21b which amplifies the voltage signal acquired from Photodiodes 8a and 8b, the high-pass filters 22a and 22b and low pass filters 23a and 23b which divide into an alternating current component and a dc component the voltage signal acquired from Amplifier 21a and 21b, dividers 24a and 24b which take the ratio of an alternating current component and a dc component, and a computing element 25 which takes the difference of the output of Dividers 24a and 24b.
[0043] Next, actuation of this data-processing section 20 is explained. The output from Photodiodes 8a and 8b is a voltage signal I1 by Amplifier 21a and 21b. (t) and I2 It is amplified by (t). This signal wave form is [0044].
[Equation 16] I1 (t) =A* (1+2delta+2theta (t))
I2 (t) =B* (1-2delta-2theta (t))
It comes out. Here, A is a constant decided by the photoelectric conversion efficiency of photodiode 8a, and amplification degree of amplifier 21a. Moreover, B is a constant decided by the photoelectric conversion efficiency of photodiode 8b, and amplification degree of amplifier 21b.
[0045] The outputs of high-pass filters 22a and 22b are A*2theta (t) and -B*2theta (t) respectively. The outputs of low pass filters 23a and 23b are A* (1+2delta) and B* (1-2delta) respectively. Doing the division of the alternating current component by the dc component with Dividers 24a and 24b, the output is [0046] respectively.
[Equation 17] M1 =2theta (t) (1-2delta)

M2 =-2theta (t) (1+2delta)
It becomes. That is, the constants A and B decided with Photodiodes 8a and 8b and Amplifier 21a and 21b are removed. In other words, the effect of the imbalance of the property of Photodiodes 8a and 8b and Amplifier 21a and 21b is lost. And it is M1 by the computing element 25. M2 A difference is acquired and this is equal to 4theta (t).
[0047]
[Equation 18] The gap delta of 4theta(t) =M1-M2, i.e., criteria polarization bearing, is offset. Moreover, in this data-processing section 20, the output of a computing element 25 outputs the wave corresponding to alternating current. And [0048]
[Equation 19] j(t) =j0 If a computing element 25 is constituted so that (M1-M2) / 4VN may be calculated so that clearly from sinomegat=theta (t)/VN=(M1-M2)/4VN, current j (t) will be called for directly.
[0049] the metering device shown in drawing 1 and drawing 2 -- energization -- a sink and measurement were performed for 200A alternating current to the conductor 1. Drawing 4 is drawing showing the oscilloscope wave of current measurement. As shown in drawing, the wave with few noises was acquired and the alternating current wave which should be measured was observed by stability. On the other hand, when the conventional electric metering device is used, an output wave is unstable, and a fixed oscilloscope observation image was not obtained.
[0050] Next, the 2nd example of the data-processing section is described. Drawing 5 is the circuit diagram of the 2nd example of the data-processing section. The amplifier 31a and 31b which amplifies the voltage signal with which the data-processing section 30 was obtained from Photodiodes 8a and 8b, The high-pass filters 32a and 32b which divide into an alternating current component and a dc component the voltage signal acquired from Amplifier 31a and 31b, and low pass filters 33a and 33b, It consists of the sensing elements 34a and 34b which change an alternating current component into actual value, dividers 35a and 35b which take the ratio of an alternating current component (actual value) and a dc component, and a computing element 36 which takes the sum of the output of Dividers 35a and 35b.
[0051] Actuation of this operation system processing section 30 is explained. The output from Photodiodes 8a and 8b is a voltage signal I1 by Amplifier 31a and 31b. (t) and I2 It is changed into (t). Those voltage signals are [0052].
[Equation 20] I1 (t) =A* (1+2delta+2theta (t))
I2 (t) =B* (1-2delta-2theta (t))
It comes out. Here, A is a constant decided by the photoelectric conversion efficiency of photodiode 8a, and amplification degree of amplifier 31a. Moreover, B is a constant decided by the photoelectric conversion efficiency of photodiode 8b, and amplification degree of amplifier 31b. And the outputs of high-pass filters 32a and 32b are A*2theta (t) and B*2theta (t) respectively. The outputs of low pass filters 33a and 33b are A* (1+2delta) and B* (1-2delta) respectively. An alternating current component is changed into actual-value A*2theta and B*2theta by sensing elements 34a and 34b. Doing the division of the alternating current component by the dc component with Dividers 35a and 35b, the output is [0053] respectively.
[Equation 21] M1 =2theta (1-2delta)
M2 =2theta (1+2delta)
The effect of the imbalance of the property of Photodiodes 8a and 8b and Amplifier 31a and 31b is lost like the case where a next door and a formula 17 explain. And it is M1 by the computing element 36. M2 Although the sum is obtained, this is equal to 4theta, the gap delta of criteria polarization bearing is offset, and it is [0054].
[Equation 22] It is set to 4 theta=M 1+M2. Therefore, it is [0055] like the case where a formula 19 explains.
[Equation 23] | The actual value of a current is calculated from j|=(M1+M2)/4VN.
[0056] Next, the temperature characteristic of the data-processing section of drawing 5 is described. Drawing 6 is drawing showing the temperature dependence of the faraday's rotation angle measured using the data-processing section 30 of drawing 5 . The white trigonum mark showed the value which

measured the value measured in the data-processing section 30 of drawing 5 in the conventional data-processing section 50 of drawing 8 by the black dot. In the conventional data-processing section 50, after performing the operation (I1-I2) / (I1+I2), the actual value of the alternating current component of the output of an arithmetic element 54 was calculated. Moreover, each of these points performs several measurement at each temperature.

[0057] Although directions of an instrument were not stabilized in the measurement which used the conventional data-processing section 50, this was considered because random fluctuation (delta) of criteria polarization bearing is added. Therefore, in the conventional data-processing section 50, since dispersion in data is large, a measurement error also becomes large, and highly precise measurement is impossible. On the other hand, when the data-processing section 30 was used, directions of an instrument were stabilized, and dispersion of two or more measurement data which can be set to each temperature decreased extremely. That is, it turned out that little highly precise measurement of a measurement error is possible. The used lead glass fiber is diamagnetism glass, and since the temperature dependence of the Verdet constant is very small, its change by the temperature of a faraday's rotation angle is also original very small. Highly precise measurement for which it does not depend on temperature by this invention taking advantage of these outstanding features of lead glass fiber was realized.

[0058] In addition, it is SiO2 as a result of experimenting further about the component of the fiber used for the above-mentioned example. The result with weight % good [weight % of 5% to 35% and PbO] at the optical fiber which consists of the lead glass which is 85 to 65% of range was obtained. That is, the small opto elastic constant was realized by the presentation of this range.

[0059] Moreover, it is SiO2 in order to realize a smaller opto elastic constant. That whose weight % of 15% to 30% and PbO weight % is 80 to 70% of range is more desirable.

[0060] In addition, what is necessary is not to be limited to semiconductor laser and just to be able to carry out the incidence of the light to optical fibers, such as other solid state laser, gas laser, a super luminescent diode, and a light emitting diode, although the semiconductor laser light source was used as the light source in the above-mentioned example. In optical system, you may have plane-of-polarization rolling mechanisms, such as a device in which an analyzer or a polarizer is rotated to an optical fiber as a device in which criteria polarization bearing is adjusted to a direction 45 degrees to the shaft of an analyzer, or a half-wave plate.

[0061] Moreover, in the above-mentioned example, although explained as a metering device of alternating current, it is applicable also to measurement of an alternating current magnetic field.

[0062]

[Effect of the Invention] Since it constituted from this invention so that might divide the output of an optical fiber into two polarization, they might be further divided into an in one direction flowed part and an alternating component, an alternating component and an in one direction flowed ratio might be taken and the ratio might be calculated as explained above, the error by imbalance, such as the property of an optoelectric transducer, and the error by change of criteria polarization bearing can be removed, and a current or a magnetic field can be measured correctly.

[0063] Moreover, with lead glass with a small photoelastic coefficient, change of criteria polarization bearing etc. can be reduced more and a current or a magnetic field can be measured more to accuracy.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Industrial Application] This invention relates to the optical fiber mold metering device and the measurement approach of measuring the current or magnetic field using the Faraday effect of an optical fiber.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] As a current metering device using the Faraday effect of an optical fiber, it is R.I.Laming and D.N.Payne, for example.; Journal of Lightwave Technology, Vol.7, and No.12 2084 (1989) What is indicated is known. Drawing 7 is drawing showing the basic configuration of the conventional optical fiber mold current metering device. energization -- Current I is flowing to the conductor 1. energization -- the optical fiber 4 which has the Faraday effect is twisted around the conductor 1. The light by which outgoing radiation was carried out from the semiconductor laser light source 2 is changed into the linearly polarized light with a polarizer 3, and is sent to an optical fiber 4. A current can be measured by change of the rotatory polarization include angle of the light sent out to the optical fiber 4 according to such optical system. Electrical treatment of the obtained light is performed as follows. The light by which outgoing radiation was carried out is separated into s wave and p wave from an optical fiber 4 by the polarization beam splitter 5. Photo electric conversion of the p wave which carries out outgoing radiation and goes straight on from a beam splitter 5 is carried out by photodiode 8a, and an another side s wave advances so that it may intersect perpendicularly by the beam splitter 5, and photo electric conversion is carried out by photodiode 8b. The voltage signal I1 by which photo electric conversion was carried out next with each photodiode, and I2 It is inputted into the data-processing section 50, and is processed as the following formula.
[0003]
[Equation 1] (I1 -I2)/(I1 +I2)
The variation theta of the polarization angle of the light generated in the optical fiber based on the result of this formula can be computed, and, finally a current value can be acquired.
[0004] namely, energization -- if it sets up so that it may become a conductor 1 with the direction of 45 degrees to the shaft of a beam splitter 5 about the direction (this is henceforth called "criteria polarization bearing") of plane of polarization in case the condition, i.e., a faraday's rotation angle, that the current is not flowing is zero, and a faraday's rotation angle is written to be theta -- [0005]
[Equation 2] sin2theta=(I1-I2)/(I1+I2)
There is relation to say and theta is calculated from this. moreover, theta -- a current -- the Verdet constant of I and an optical fiber -- energization of V and an optical fiber -- the number of the circumference to a conductor -- N, then [0006]
[Equation 3] There is relation called theta=VNI and it is [0007].
[Equation 4] It can come I=theta/VN and Current I can be found more. theta can approximate with sin2theta=2theta, when small.
[0008] Drawing 8 is the circuit diagram of the data-processing section which performs the above-mentioned operation. The data-processing section 50 consists of the amplifier 51a and 51b which amplifies the voltage signal acquired from Photodiodes 8a and 8b, the arithmetic element 52 which acquires the difference of the voltage signal acquired from Amplifier 51a and 51b, an arithmetic element 53 which obtains the sum of the voltage signal acquired from Amplifier 51a and 51b, and an arithmetic element 54 which takes the ratio of the output of an arithmetic element 52, and the output of an arithmetic element 53.

[0009] It is an output I1 and I2 from Amplifier 51a and 51b, respectively. It is obtained. an output (I1+I2) obtains from the output (I1-I2) from an arithmetic element 52, and an arithmetic element 53 -- having -- an arithmetic element 54 -- those ratios (I1-I2) -- / (I1+I2) is outputted.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since it constituted from this invention so that might divide the output of an optical fiber into two polarization, they might be further divided into an in one direction flowed part and an alternating component, an alternating component and an in one direction flowed ratio might be taken and the ratio might be calculated as explained above, the error by imbalance, such as the property of an optoelectric transducer, and the error by change of criteria polarization bearing can be removed, and a current or a magnetic field can be measured correctly.
[0063] Moreover, with lead glass with a small photoelastic coefficient, change of criteria polarization bearing etc. can be reduced more and a current or a magnetic field can be measured more to accuracy.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, generally as an optical fiber of such a current metering device, quartz glass fiber or lead glass fiber is used.
[0011] An opto elastic constant is large, the stress induced birefringence based on a birefringence or a temperature change by residual stress of a fiber etc. is large, and a quartz fiber tends to produce the error of current measurement. In order to reduce the instability of the polarization property by such birefringence, the method of giving big **** to a fiber is also proposed. Although it was the attempt in which this would be twisted using the large thing of an opto elastic constant, and the stability of plane-of-polarization bearing would be maintained with stress, the stability over change of environments, like originally, since the opto elastic constant is large, with deformation of a fiber, the stress from the outside, etc., a random birefringence occurs easily and a temperature change and vibration are added was inadequate.
[0012] On the other hand, lead glass fiber has the advantage of there being few errors by stress induced birefringence since the opto elastic constant is very small, and being hard to be influenced of the stress by the environmental variation. However, criteria polarization bearing cannot be stabilized with a means to give a twist conversely to a fiber with lead glass fiber since the opto elastic constant is very small. moreover -- even if it sets up criteria polarization bearing once -- energization -- when the geometry of the fiber which winds a conductor changes under change of an outside temperature, and the effect of prolonged use, changing from the direction set up first occurs plentifully. Therefore, since measured value generated the measurement error as dispersion and a result when lead glass fiber was used for the optical fiber 4 of drawing 7 , and the output was processed in the data-processing section 50, and changing criteria polarization bearing by deformation and vibration of a fiber, there was a trouble that the advantage of lead glass fiber was not fully demonstrated.
[0013] Moreover, at the data-processing section 50 shown in drawing 8 , it is I1 and I2 by the imbalance of the property of two photodiodes 8a and 8b, or the imbalance of the amplification degree of Amplifier 51a and 51b. In order to change, there is also a trouble of producing a measurement error.
[0014] This invention is being made in view of such a point, and the purpose's removing the error by the imbalance of properties, such as an optoelectric transducer, and the error based on the fluctuation of criteria polarization bearing of light which carries out outgoing radiation, and offering a highly precise current or the optical fiber mold metering device which can measure a magnetic field.
[0015] Furthermore, other purposes of this invention are removing the error by the imbalance of properties, such as an optoelectric transducer, and the error based on fluctuation of criteria polarization bearing, and offering a highly precise current or the optical fiber mold measurement approach which can measure a magnetic field.

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MEANS

[Means for Solving the Problem] In the optical fiber mold metering device which performs measurement of a current or a magnetic field from change of the plane of polarization by the Faraday effect of the light by which outgoing radiation was carried out from the optical fiber in order to solve the above-mentioned technical problem in this invention energization -- it being prepared in the perimeter of a conductor or a magnetic field, and with the optical fiber made from lead glass to which the light guide of the light is carried out A polarization separation means to separate into the 1st polarization and the 2nd polarization which have plane of polarization which is mutually different in the outgoing radiation light of said optical fiber, A photoelectricity conversion means to change respectively said 1st polarization and said 2nd polarization into the 1st polarization electrical signal and the 2nd polarization electrical signal, A separation means to divide respectively said 1st polarization electrical signal and said 2nd polarization electrical signal into the 1st alternating current component, the 1st dc component and the 2nd alternating current component, and the 2nd dc component, A division means to ask for the 1st component ratio of said 1st alternating current component and said 1st dc component, and the 2nd component ratio of said 2nd alternating current component and said 2nd dc component respectively, The optical fiber mold metering device characterized by having an operation means to ask for the difference or the sum of said 1st component ratio and said 2nd component ratio is offered.

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OPERATION

[Function] The light guide of the light is carried out to an optical fiber, and, as for the outgoing radiation light, plane of polarization changes with a current or magnetic fields. It separates into the 1st polarization and the 2nd polarization which have the plane of polarization which changed the outgoing radiation light mutually with polarization separation means, and changes into the 1st polarization electrical signal and the 2nd polarization electrical signal with a photo-electric-conversion means. And the 1st polarization electrical signal and the 2nd polarization electrical signal are separated into the 1st alternating current component, the 1st dc component, the 2nd alternating current component, and the 2nd dc component by the separation means. Furthermore, it asks for the 1st component ratio and the 2nd component ratio with a division means.
[0018] By asking for the component ratio of each alternating current component and dc component, the error by the imbalance of the property of each photo-electric-conversion means is removed. Moreover, it asks for the difference or the sum of the 1st component ratio and the 2nd component ratio with an operation means. The error by change of criteria polarization bearing is removed by this.
[0019] And measurement of a current or a magnetic field without the error by the imbalance of the property of a photo-electric-conversion means and the error by change of criteria polarization bearing can be performed.

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EXAMPLE

[Example] Hereafter, one example of this invention is explained based on a drawing. Drawing 1 is the principle Fig. of this invention. this invention -- from optical system and the data-processing section -- becoming -- optical system -- energization -- with the optical fiber 4 which consists of lead glass wound twice around the conductor 1 The polarizer 3 which makes light by which outgoing radiation was carried out to this optical fiber 4 from the semiconductor laser light source 2 which supplies a measuring beam, and the semiconductor laser light source 2 the linearly polarized light, The polarization which has the plane of polarization which intersected perpendicularly mutually the light by which outgoing radiation was carried out from the optical fiber 4, That is, it consists of photodiodes 8a and 8b which change into a voltage signal the light by which the light guide was carried out to the quartz glass fiber 6 and 7 which carries out the light guide of the measuring beam by which outgoing radiation was carried out, and quartz glass fiber 6 and 7 from the analyzer 5 divided into s component and p component, and an analyzer 5.
[0021] An optical fiber 4 is a three-tiered structure optical fiber which consists of a core made from lead glass, a clad, and an exaggerated clad, and the presentation is as follows.
Core glass presentation (all are weight %)
SiO2 : 27.10%PbO : 71.10%Na2 O: 0.20%K2 O : 1.30% clad glass presentation SiO2 : 27.25%PbO : 70.95%Na2 O: 0.20%K2 O : It is SiO2 1.30% here. PbO is the principal component of lead glass. Na2 O and K2 O are components which maintain a vitreous state at stability by promoting vitrification and controlling crystallization.
exaggerated -- clad glass presentation SiO2 1.31%Cr2 O3: 0.05%Cu2 O : [ ] -- 1.01%, SiO2 and PbO are the principal components of lead glass, and the component, and Cr 2O3 and Cu2 O to which Na2 O promotes vitrification are an absorbent for absorbing the clad mode of an optical fiber here. : 27.23% PbO : 70.42%Na2 O :
[0022] Moreover, each diameter and refractive index are as follows.

	直径	屈折率
コア	5．7μm	1．85186
クラッド	31．7μm	1．84857
オーバークラッド	125μm	1．85746

0.17%, 0.11 and normalized radiam frequency of numerical aperture are 2.35, and the relative index difference of a fiber fulfills single mode conditions to light with a wavelength of 850nm. The Verdet constants were about 0.04 min/Oe-cm on the wavelength of 850nm.
[0023] Incidence of the measuring beam which carried out outgoing radiation from the semiconductor laser light source 2 by the above configuration is carried out to the glory fiber 4 changed into the linearly polarized light by the polarizer 3. the light which carried out incidence to the optical fiber 4 -- energization -- according to the magnitude of the current which passes the part which are surrounding the conductor 1, plane of polarization rotates and outgoing radiation is carried out by the Faraday effect from an optical fiber 4. Outgoing radiation is carried out, incidence of the measuring beam is carried out

to an analyzer 5, and it is separated into s wave and p wave by this analyzer 5. The light guide of the p wave is carried out to photodiode 8a with quartz glass fiber 6, and the light guide of the s wave is carried out to photodiode 8b with quartz glass fiber 7.
[0024] The data-processing section 10 consists of an operation means 13 to ask for the difference or the sum of separation means 11a and 11b to divide a polarization electrical signal into an alternating current and a direct current, division means 12a and 12b to ask for the component ratio of each alternating current component and dc component, and a component ratio.
[0025] With the separation means 11a and 11b, it separates into an alternating current component and a dc component, and the 1st polarization electrical signal and the 2nd polarization electrical signal which were outputted from Photodiodes 8a and 8b become the 1st alternating current component, the 1st dc component, the 2nd alternating current component, and the 2nd dc component. Furthermore, it asks for the 2nd component ratio which are the 1st component ratio which is a ratio of the 1st alternating current component and the 1st dc component, and a ratio of the 2nd alternating current component and the 2nd dc component with the division means 12a and 12b. And it asks for the difference or the sum of the 1st component ratio and the 2nd component ratio with the operation means 13.
[0026] Next, actuation of the data-processing section 10 is explained quantitatively. Drawing 2 is drawing explaining criteria polarization bearing. As shown in drawing, the criteria polarization bearing Er is set up so that the include angle of 45 degrees may be made to the shaft of an analyzer. However, when only an include angle delta shifts from 45 degrees and this serves as Era, it is the faraday's rotation angle caused by the measurement current theta then the voltage signal I1 of Photodiodes 8a and 8b, and I2 [0027]
[Equation 5] I1 =A* (1+sin (2theta+2delta))
I2 =B* (1-sin (2theta+2delta))
It becomes. A and B are the amplification degree of the photodiodes 8a and 8b to each polarization component here. In A=B, with the conventional method, it is [0028].
[Equation 6] S**(I1-I2)/(I1+I2) =cos (2theta+2delta)
It comes out, and it is and, as for a faraday's rotation angle, only delta produces a gap error. delta will change with deformation of a fiber winding configuration or vibration of a fiber, and the error by the drift at the time of using it for a long period of time and the random error by vibration will be included in measured value as a result. Moreover, an error is produced also when A differs from B.
[0029] When measuring alternating current, since theta changes with time amount according to alternating current, it describes it as theta (t). At this time, it is the passed current j(t) =j0 When sinomegat, the faraday's rotation angle corresponding to this is [0030].
[Equation 7] theta(t) =theta0 It is sinomegat and a faraday's rotation angle vibrates by omega. V is the Verdet constant, N is the number of turns of an optical fiber, and it is [0031] here.
[Equation 8] It is theta0 =VNj0.
[0032] It is the voltage signal of the return photodiodes 8a and 8b to drawing 1 I1 and I2 It is [0033] when it carries out.
[Equation 9]
I1 (t) =A* (1+sin (2theta (t) +2delta))
I2 (t) =B* (1-sin (2theta (t) +2delta))
Although expressed, theta (t) and delta are both [0034], when small.
[Equation 10]
sin(2theta (t) +2delta) **2theta (t) Since it is +2delta, it is [0035].
[Equation 11]
I1 (t) =A0 * (1+2delta+2theta (t))
I2 (t) =B0 * (1-2delta-2theta (t))
It can approximate.
[0036] Next, it is I1 with the separation means 11a and 11b. (t) and I2 (t) Each is divided into an alternating current component (2theta (t), -2theta (t)) and a dc component (1+2delta, 1-2delta). And it asks for the component ratio of each alternating current component and dc component with the division

means 12a and 12b. They are those component ratios to order M1 (t) and M2 It is [0037], when it is written as (t) and approximation called delta<<1 is used.
[Equation 12] M1 (t) =A0 *[2theta(t)]/A0 * (1+2delta)
**2theta (t) (1-2delta)
M2 (t) =B0 *[-2theta(t)]/B0 * (1-2delta)
**-2theta (t) (1+2delta)
It becomes. It is amplification degree A0 and B0 so that clearly from this formula. It is eliminated and the measurement error by it is lost.
[0038] And it is M1 with the operation means 13. (t) and M2 It is [0039] when the difference of (t) is searched for.
[Equation 13] M1 (t)-M2 (t) =4theta (t)
A next door and M1 (t) and M2 The gap delta of criteria polarization bearing can be offset by taking the difference of (t). And [0040]
[Equation 14]
theta(t) =theta0 Sinomegat=VNj 0 Since it is sinomegat, it is [0041].
[Equation 15] It can ask for current j (t) from j(t) = j-sinomegat=theta (t) / VN.
[0042] Next, the example of the data-processing section 10 is described. Drawing 3 is the circuit diagram of the 1st example of the data-processing section. The data-processing section 20 consists of the amplifier 21a and 21b which amplifies the voltage signal acquired from Photodiodes 8a and 8b, the high-pass filters 22a and 22b and low pass filters 23a and 23b which divide into an alternating current component and a dc component the voltage signal acquired from Amplifier 21a and 21b, dividers 24a and 24b which take the ratio of an alternating current component and a dc component, and a computing element 25 which takes the difference of the output of Dividers 24a and 24b.
[0043] Next, actuation of this data-processing section 20 is explained. The output from Photodiodes 8a and 8b is a voltage signal I1 by Amplifier 21a and 21b. (t) and I2 It is amplified by (t). This signal wave form is [0044].
[Equation 16] I1 (t) =A* (1+2delta+2theta (t))
I2 (t) =B* (1-2delta-2theta (t))
It comes out. Here, A is a constant decided by the photoelectric conversion efficiency of photodiode 8a, and amplification degree of amplifier 21a. Moreover, B is a constant decided by the photoelectric conversion efficiency of photodiode 8b, and amplification degree of amplifier 21b.
[0045] The outputs of high-pass filters 22a and 22b are A*2theta (t) and -B*2theta (t) respectively. The outputs of low pass filters 23a and 23b are A* (1+2delta) and B* (1-2delta) respectively. Doing the division of the alternating current component by the dc component with Dividers 24a and 24b, the output is [0046] respectively.
[Equation 17] M1 =2theta (t) (1-2delta)
M2 =-2theta (t) (1+2delta)
It becomes. That is, the constants A and B decided with Photodiodes 8a and 8b and Amplifier 21a and 21b are removed. In other words, the effect of the imbalance of the property of Photodiodes 8a and 8b and Amplifier 21a and 21b is lost. And it is M1 by the computing element 25. M2 A difference is acquired and this is equal to 4theta (t).
[0047]
[Equation 18] The gap delta of 4theta(t) =M1-M2, i.e., criteria polarization bearing, is offset. Moreover, in this data-processing section 20, the output of a computing element 25 outputs the wave corresponding to alternating current. And [0048]
[Equation 19] j(t) =j0 If a computing element 25 is constituted so that (M1-M2) / 4VN may be calculated so that clearly from sinomegat=theta (t)/VN=(M1-M2)/4VN, current j (t) will be called for directly.
[0049] the metering device shown in drawing 1 and drawing 2 -- energization -- a sink and measurement were performed for 200A alternating current to the conductor 1. Drawing 4 is drawing showing the oscilloscope wave of current measurement. As shown in drawing, the wave with few noises was

acquired and the alternating current wave which should be measured was observed by stability. On the other hand, when the conventional electric metering device is used, an output wave is unstable, and a fixed oscilloscope observation image was not obtained.

[0050] Next, the 2nd example of the data-processing section is described. Drawing 5 is the circuit diagram of the 2nd example of the data-processing section. The amplifier 31a and 31b which amplifies the voltage signal with which the data-processing section 30 was obtained from Photodiodes 8a and 8b, The high-pass filters 32a and 32b which divide into an alternating current component and a dc component the voltage signal acquired from Amplifier 31a and 31b, and low pass filters 33a and 33b, It consists of the sensing elements 34a and 34b which change an alternating current component into actual value, dividers 35a and 35b which take the ratio of an alternating current component (actual value) and a dc component, and a computing element 36 which takes the sum of the output of Dividers 35a and 35b.

[0051] Actuation of this operation system processing section 30 is explained. The output from Photodiodes 8a and 8b is a voltage signal I1 by Amplifier 31a and 31b. (t) and I2 It is changed into (t). Those voltage signals are [0052].

[Equation 20] I1 (t) =A* (1+2delta+2theta (t))

I2 (t) =B* (1-2delta-2theta (t))

It comes out. Here, A is a constant decided by the photoelectric conversion efficiency of photodiode 8a, and amplification degree of amplifier 31a. Moreover, B is a constant decided by the photoelectric conversion efficiency of photodiode 8b, and amplification degree of amplifier 31b. And the outputs of high-pass filters 32a and 32b are A*2theta (t) and B*2theta (t) respectively. The outputs of low pass filters 33a and 33b are A* (1+2delta) and B* (1-2delta) respectively. An alternating current component is changed into actual-value A*2theta and B*2theta by sensing elements 34a and 34b. Doing the division of the alternating current component by the dc component with Dividers 35a and 35b, the output is [0053] respectively.

[Equation 21] M1 =2theta (1-2delta)

M2 =2theta (1+2delta)

The effect of the imbalance of the property of Photodiodes 8a and 8b and Amplifier 31a and 31b is lost like the case where a next door and a formula 17 explain. And it is M1 by the computing element 36. M2 Although the sum is obtained, this is equal to 4theta, the gap delta of criteria polarization bearing is offset, and it is [0054].

[Equation 22] It is set to 4 theta=M 1+M2. Therefore, it is [0055] like the case where a formula 19 explains.

[Equation 23] | The actual value of a current is calculated from j|=(M1+M2)/4VN.

[0056] Next, the temperature characteristic of the data-processing section of drawing 5 is described. Drawing 6 is drawing showing the temperature dependence of the faraday's rotation angle measured using the data-processing section 30 of drawing 5 . The white trigonum mark showed the value which measured the value measured in the data-processing section 30 of drawing 5 in the conventional data-processing section 50 of drawing 8 by the black dot. In the conventional data-processing section 50, after performing the operation (I1-I2) / (I1+I2), the actual value of the alternating current component of the output of an arithmetic element 54 was calculated. Moreover, each of these points performs several measurement at each temperature.

[0057] Although directions of an instrument were not stabilized in the measurement which used the conventional data-processing section 50, this was considered because random fluctuation (delta) of criteria polarization bearing is added. Therefore, in the conventional data-processing section 50, since dispersion in data is large, a measurement error also becomes large, and highly precise measurement is impossible. On the other hand, when the data-processing section 30 was used, directions of an instrument were stabilized, and dispersion of two or more measurement data which can be set to each temperature decreased extremely. That is, it turned out that little highly precise measurement of a measurement error is possible. The used lead glass fiber is diamagnetism glass, and since the temperature dependence of the Verdet constant is very small, its change by the temperature of a faraday's rotation angle is also original very small. Highly precise measurement for which it does not

depend on temperature by this invention taking advantage of these outstanding features of lead glass fiber was realized.

[0058] In addition, it is SiO2 as a result of experimenting further about the component of the fiber used for the above-mentioned example. The result with weight % good [weight % of 5% to 35% and PbO] at the optical fiber which consists of the lead glass which is 85 to 65% of range was obtained. That is, the small opto elastic constant was realized by the presentation of this range.

[0059] Moreover, it is SiO2 in order to realize a smaller opto elastic constant. That whose weight % of 15% to 30% and PbO weight % is 80 to 70% of range is more desirable.

[0060] In addition, what is necessary is not to be limited to semiconductor laser and just to be able to carry out the incidence of the light to optical fibers, such as other solid state laser, gas laser, a super luminescent diode, and a light emitting diode, although the semiconductor laser light source was used as the light source in the above-mentioned example. In optical system, you may have plane-of-polarization rolling mechanisms, such as a device in which an analyzer or a polarizer is rotated to an optical fiber as a device in which criteria polarization bearing is adjusted to a direction 45 degrees to the shaft of an analyzer, or a half-wave plate.

[0061] Moreover, in the above-mentioned example, although explained as a metering device of alternating current, it is applicable also to measurement of an alternating current magnetic field.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the principle Fig. of this invention.
[Drawing 2] It is drawing explaining criteria polarization bearing.
[Drawing 3] It is the circuit diagram of the 1st example of the data-processing section.
[Drawing 4] It is drawing showing the oscilloscope wave of current measurement.
[Drawing 5] It is the circuit diagram of the 2nd example of the data-processing section.
[Drawing 6] It is drawing showing the temperature dependence of a faraday's rotation angle.
[Drawing 7] It is drawing showing the basic configuration of the conventional optical fiber mold current metering device.
[Drawing 8] It is the circuit diagram of the conventional data-processing section.
[Description of Notations]
1 Energization -- Conductor
2 Semiconductor Laser Light Source
3 Polarizer
4 Optical Fiber
5 Analyzer
8a, 8b Photodiode
10 Data-Processing Section
11a, 11b Separation means
12a, 12b Division means
13 Operation Means

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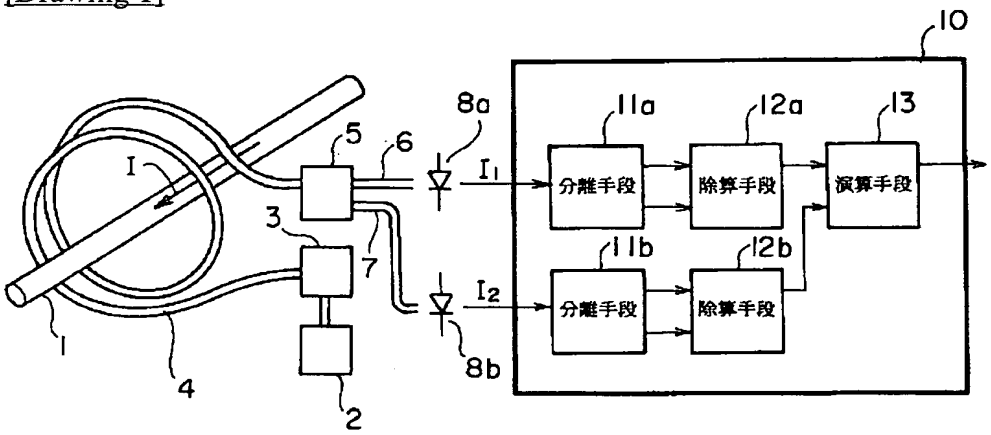
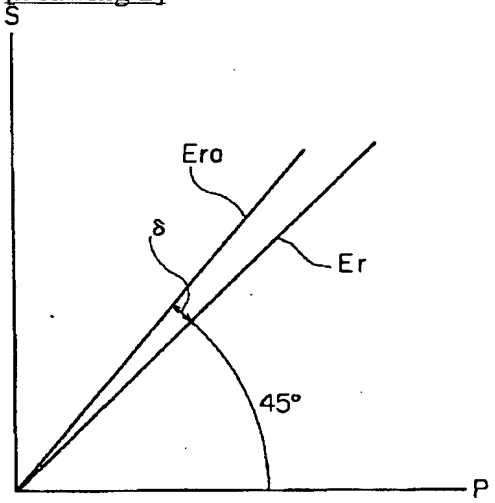
DRAWINGS

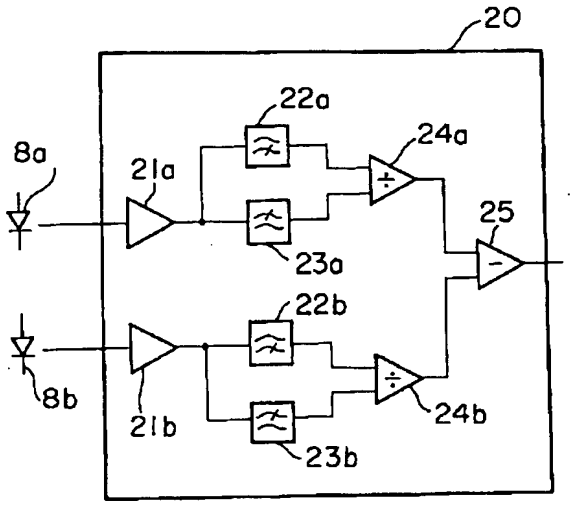
[Drawing 1]



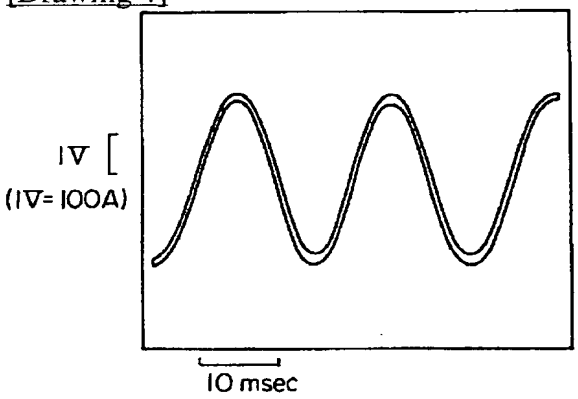
[Drawing 2]



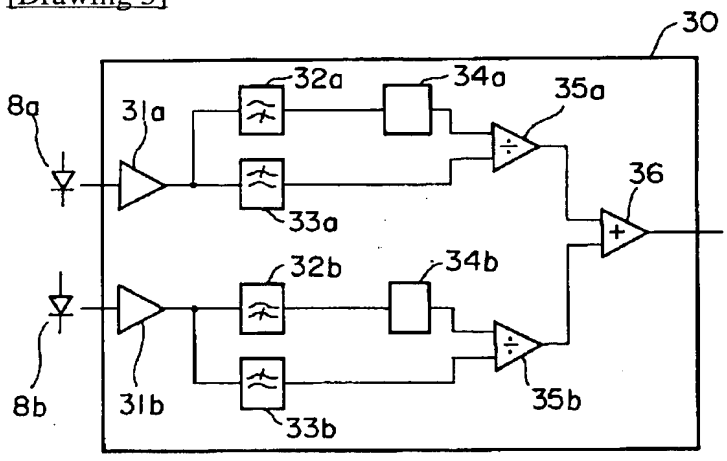
[Drawing 3]



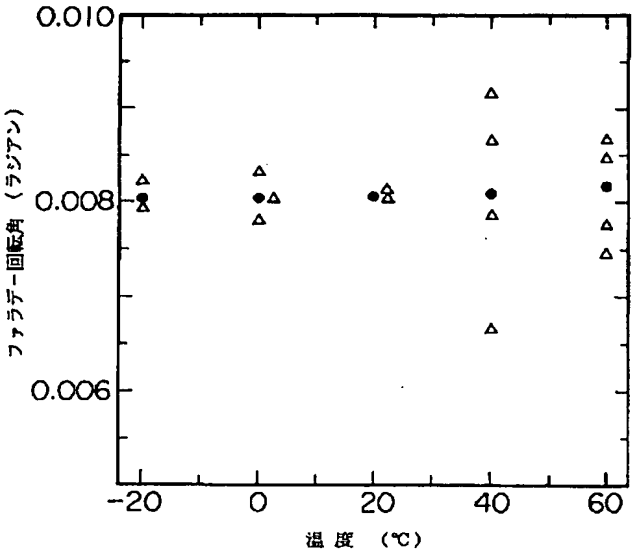
[Drawing 4]



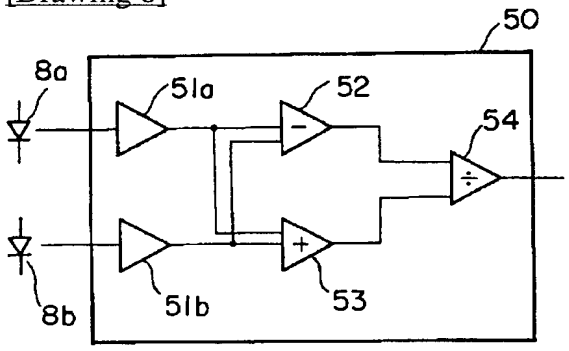
[Drawing 5]



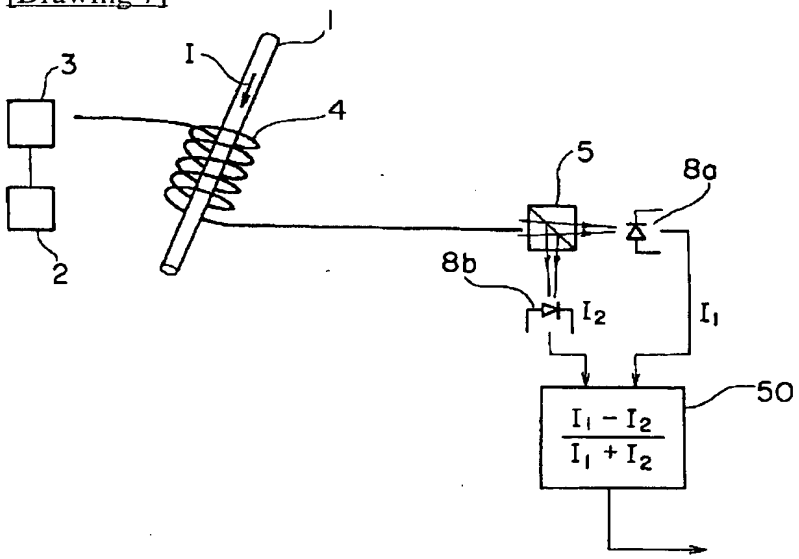
[Drawing 6]



[Drawing 8]



[Drawing 7]



[Translation done.]